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Evaluation and Clinical Outcomes of Abdominal Trauma Patients at a Tertiary Care Single Centre: A Prospective Observational Study

Dr. Anubhav Goel[1], Dr. Aradhana Singh[2], Dr. Mohd Zafar Husain[3]

[1]Associate Professor, Department of General Surgery, S.N. Medical College, Agra
[2]Associate Professor, Department of General Surgery, S.N. Medical College, Agra
[3]Junior Resident, Department of General Surgery, S.N. Medical College, Agra

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Corresponding Author:

Dr. Mohd Zafar Husain
Junior Resident, Department of General Surgery, S.N. Medical College, Agra

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ABSTRACT

Background: Abdominal trauma remains a significant contributor to preventable morbidity and death, particularly in low- and middle-income settings where road traffic injury and delayed access to definitive care continue to affect outcomes. The clinicoradiological profile, management pathway and short-term outcomes of abdominal trauma patients treated at a tertiary care centre were evaluated in this study with specific emphasis on the discriminative value of the New Injury Severity Score (NISS) and Clinical Abdominal Scoring System (CASS).

Methods: This prospective observational study comprised consecutive patients of radiologically confirmed abdominal trauma that were treated in the Department of Surgery,
S.N. Medical College, Agra from November 2023 to October 2025. Demographic information, mechanism of injury, hemodynamic variables, imaging data, operative and nonoperative management status, complications, intensive care unit (ICU) utilization, hospital stay, and in-hospital mortality were collected. Comparative analyses were conducted between operative and nonoperative groups and based on laparotomy status, and score-performance analyses were done.

Results: Of the fifty patients studied, 39 (78.0%) were men. Operative management was required in 20 (40.0%) patients and laparotomy in 16 (32.0%). The most common mechanism of injury was due to road traffic crashes (48.0%) followed by falls (30.0%). The operative group was more severely injured than the non-operative group (higher NISS: 43.80 ± 10.98 vs 20.77 ± 9.58; $p < .001$), a higher CASS (median 9.5 vs 8.5; $p = .031$), prolonged ICU stay (median 3 vs 1 days; $p < .001$), an extended length of stay in hospital (11.35 ± 2.21 vs 6.83 ± 1.78 days; $p < .001$), significantly increased operation, laparotomy, and length of admission among patients with NISS ≥25. In the adjusted analysis, operative care independently predicted length of hospital stay (beta 4.636, $p < .001$). Overall mortality was 4.0%.

Conclusion: In this single-centre cohort, abdominal trauma management was driven primarily by injury severity and physiologic burden rather than demographic factors or mechanism alone. NISS was a stronger discriminator of intervention burden and prolonged hospitalization than CASS, supporting severity-based triage and close monitoring of high-risk patients.

Keywords*: abdominal trauma; laparotomy; non-operative management; injury severity; NISS; CASS; outcomes.*

INTRODUCTION

Abdominal trauma still poses difficulties to emergency surgery, as its clinical course from mild occult injury to sudden fatal hemorrhagic collapse can be diverse. Abdominal trauma continues to be a major factor in modern trauma systems, with

road traffic accidents, falls, workplace trauma, and interpersonal violence being the leading underlying causes of abdominal trauma. Road traffic injury results in an estimated 1.19 million deaths [1], with the greatest impact observed among LMICs. Global burden studies show that injuries are still an important factor leading to premature death and disability in the young and economically prosperous populations [2]. In such a broader load, the abdominal trauma is particularly pertinent because uncontrolled bleeding and deferred monitoring of hollow viscus injury is strongly related to avoidable mortality. Abdominal trauma was formerly an obligatory exploration; however, physiology-guided and imaging-driven targeted intervention have supplanted it. Although the primary treatment should remain guided by the criteria of Advanced Trauma Life Support and regular airway, breathing, circulation and disability assessments, bedside imaging and structured resuscitation are now recognized as "front-runners" to identify patients suffering from acute needs for aggressive surgical management [3,4]. FAST has completely transformed the bedside early identification of unstable patients, enabling rapid identification of free intraperitoneal fluid [5]. In hemodynamically stable patients, contrast-enhanced computed tomography (CT) remains the gold standard since it delineates solid-organ injury, detects active bleeding, and enhances findings for bowel and mesenteric trauma [6]. With these developments, non-operative management of most hepatic and splenic lesions in stable patients has been preferred, which could be followed with close follow-up, blood-product support, and rescue intervention [7]. However, a patient with sustained hemodynamic instability, diffuse peritonitis, or an acute suspicion of severe bowel injury still requires early surgical exploration. Also, the combination of balanced transfusion and damage-control resuscitation in those with exsanguinating trauma will enhance damage-control surgery by preventing hemorrhage-related death in these patients and providing early hemostasis [8]. But patient outcomes remain vastly different between institutions because of the influence of referral trends, transport delay, availability of CT, ICU capability, blood bank preparedness, and specialization in surgical and radiology for the treatment of trauma. This indicates that local observational data play a critical clinical role. Nevertheless, single-centred studies offer important information about how the association between mechanism of injury, physiologic presentation, profile of injury severity, management trajectory and short-term outcome is realised in a given type of practice. These are particularly relevant for Indian tertiary hospitals where mixed trauma burden and evolving protocols may contribute to forming an intervention threshold. So severity scoring can be used to even more refine the decision-making. The New Injury Severity Score (NISS) estimates cumulative anatomic burden across all three of the most severe injuries regardless of body region, and is the sum of the squares of the 3, and Clinical Abdominal Scoring System (CASS) aims to convert bedside physiologic and abdominal signs to a tangible triage tool. The current review consisted of an investigation of the clinical course, management strategies and short-term outcomes by abdominal trauma patients who were being treated at a tertiary care single centre. Their primary goals were to compare operative and non-operative pathways for injury severity and outcome, and secondary objectives were to evaluate factors associated with laparotomy, complication, and longer length of stay, and the functions of NISS and CASS as intervention burdens within this population.

MATERIALS AND METHODS

Study Design and Setting

This prospective observational study was conducted in the Department of Surgery, S.N. Medical College, Agra, a tertiary care referral centre. The study was carried out over a period of 24 months, from November 2023 to October 2025. All patients presenting with abdominal trauma during the study period were screened for eligibility and enrolled consecutively after fulfillment of the selection criteria.

Study Population

The study population comprised patients presenting to the emergency department with a history suggestive of abdominal trauma. On arrival, all patients underwent primary survey, resuscitation, and stabilization according to Advanced Trauma Life Support (ATLS) principles. Patients were further evaluated after initial hemodynamic stabilization.

Eligibility Criteria Inclusion Criteria

Patients were included if they met all of the following criteria:

1. Presentation with a clinical history of blunt or penetrating abdominal trauma.
2. Radiological evidence of intra-abdominal injury on focused assessment with sonography for trauma (eFAST), plain radiography, or contrast-enhanced computed tomography (CECT).

Exclusion Criteria

Patients were excluded if they met any of the following criteria:

1. They were brought dead to the emergency department.
2. They or their attendants were unwilling to participate in the study.
3. No radiological evidence of intra-abdominal injury was identified.

Sampling Method and Sample Size

A census-based sampling strategy was adopted. All eligible patients admitted with abdominal trauma during the defined study period were included in the study. No predetermined sample size calculation was applied, and the final sample consisted of all consecutively enrolled cases.

Clinical Evaluation and Data Collection

The detailed clinical history of all patients (age, sex, mechanism of injury, type of trauma, mode of injury, and time interval from trauma to hospital presentation and from admission to intervention) was obtained. Clinical examination focused primarily on abdominal findings and associated extra-abdominal injuries. Baseline assessment: Complete blood count, blood glucose, renal function tests, serum electrolytes, liver function tests, and viral markers. Radiologic investigations included eFAST for hemoperitoneum or free intraperitoneal fluid, chest and abdominal radiography to detect free air or diaphragmatic injury as needed, and contrast-enhanced computed tomography in hemodynamically stable patients to determine the diagnosis and assess severity of injury. The data was prospectively recorded on a structured case record form. A complete summary of the management, operative findings (if any), complications, intensive care required, and length of hospitalization was documented during hospitalization.

Study Variables and Outcome Measures

The following parameters were evaluated:

- Age and sex distribution
- Mechanism and type of trauma (blunt or penetrating)
- Presenting symptoms and clinical features
- Time from trauma to admission and from admission to intervention
- Associated injuries
- Type of management, categorized as non-operative management (NOM) or operative intervention
- Requirement of laparotomy
- Duration of intensive care unit stay
- Total duration of hospital stay
- In-hospital complications
- In-hospital mortality

Trauma Severity Scoring

To assess injury severity and its relationship with outcome, two scoring systems were applied:

New Injury Severity Score (NISS)

The New Injury Severity Score was used to quantify anatomic injury burden by summing the squares of the three most severe injuries, irrespective of body region. It was used as a marker of overall trauma severity and for comparison with intervention and clinical outcomes.

Clinical Abdominal Scoring System (CASS)

The Clinical Abdominal Scoring System was used as a physiological bedside scoring method based on variables such as pulse rate, blood pressure, respiratory rate, and abdominal clinical findings. It was evaluated for its usefulness in predicting the need for operative intervention, prolonged hospital stay, and in-hospital outcome.

Management Protocol

Patients were categorized into operative and non-operative groups based on hemodynamic status, radiological findings, and clinical progression. Operative intervention was undertaken in patients with hemodynamic instability, generalized peritonitis, hollow viscus injury, uncontrolled hemorrhage, or failure of non-operative management. Hemodynamically stable patients without peritonitis or evidence of ongoing bleeding were managed conservatively with serial clinical monitoring, supportive care, and repeat imaging when required.

Statistical Analysis

All the collected data were recorded in Microsoft Excel, and calculated by the statistical package suitable for statistical analysis. Categorical variables were expressed as frequencies and percentages and that of continuous variables as means ± standard deviation or median with interquartile range as appropriate. For categorical variables, comparison with other categorical variables the chi-square test or Fisher exact test was applied. A Student t-test, analysis of variance (ANOVA), or other non-parametric tests were applied for continuous variables according to data distribution. A p value < 0.05 was considered statistically significant.

Ethical Considerations

The study was conducted after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants or their legally authorized representatives before enrollment. Patient confidentiality and data privacy were maintained throughout the study.

RESULTS

A total of 50 patients with abdominal trauma were analysed. Of those who participated in the cohort, men accounted for

78.0%. The most frequent mechanisms of injury were road traffic crashes: 48.0%, fall (30.0%), and assault-related trauma (18.0%). Operative management included 20 patients (40.0%), 30 patients (60.0%) were treated non-operatively, whereas 16 patients (32.0%) underwent laparotomy. The most reported abdominal organ injuries were liver (44.0%) and splenic (42.0%) injuries, and there were 31 patients (62.0%) who had at least one associated extra-abdominal injury. Baseline population characteristics and extensive mechanisms of injury were comparable for all management groups. The distribution of sex, smoking exposure, assault-related presentation, road traffic mechanism, fall-related mechanism, or hours to presentation did not differ significantly between the operative and nonoperative cohorts. This comparability suggests that treatment pathway divergences likely did not arise from a baseline imbalance. The most significant differentiating factors between the groups were those related to injury severity and early physiologic burden. Patients with operative involvement had significantly higher highest, second, and third AIS component scores including a much higher mean NISS and a small but significant difference in median CASS when evaluated compared to patients with no surgical intervention. A related relationship became apparent when assessing the laparotomy status: Patients who underwent laparotomy displayed a significantly increased pulse rate, but age, body mass index, blood pressure, and Glasgow Coma Scale were not significantly different. The findings suggest that surgical decision-making was predominantly shaped by the nature of the severity architecture of injury and level of circulatory pressure. Results were similar according to the severity gradient. Surgical patients had a prolonged ICU admission and hospital stay, and admission beyond 7 days was significantly more frequent among recipients of advanced operative treatment in this subgroup compared to controls. The number of complications and mortality compared to postoperative treatment was numerically greater but not significant because the number of events was small. NISS stratification confirmed that severity was significantly related to intervention burden: patients with NISS ≥25 had significantly higher operative rates, increased laparotomy rates, and more delayed follow-up admissions than individuals with lower NISS scores. In an adjusted linear regression model, operative management was the sole predictor that independently led to longer hospital admission, with the length of stay extending for an average of 4.6 days after adjusting for age, sex, BMI, baseline systolic pressure, NISS, and CASS.

TABLE 1. BASELINE PROFILE, MECHANISM, AND SEVERITY BY MANAGEMENT GROUP

Variable	Operative (n=20)	Non-operative (n=30)	Effect summary	P value
Male sex	14 (70.0)	25 (83.3)	OR 0.47 (95% CI 0.12-1.81)	.311
Road traffic accident	8 (40.0)	16 (53.3)	OR 0.58 (95% CI 0.19-1.84)	.355
Hours to presentation	2.10 [1.58-3.00]	2.50 [1.88-3.38]	Rank-biserial r=0.205	.227
Highest AIS component	5.00 [4.00-5.00]	3.00 [3.00-4.00]	Rank-biserial r=-0.785	<.001
NISS total	43.80 ± 10.98	20.77 ± 9.58	Cohen's d=2.268	<.001
CASS total	9.50 [8.00-11.00]	8.50 [7.00-9.00]	Rank-biserial r=-0.357	.031

INTERPRETATION

The treatment groups were demographically similar, but the operative cohort showed a distinctly higher severity signature. The absence of significant difference in sex, mechanism, and arrival interval reduces the likelihood that simple baseline imbalance explained treatment allocation. In contrast, the sharp rise in highest AIS, NISS, and CASS values among operative patients indicates that clinicians were responding to injury seriousness and physiologic threat rather than to the social or mechanistic context of injury alone.

TABLE 2. ORGAN INJURY AND ASSOCIATED INJURY PROFILE BY MANAGEMENT GROUP

Variable	Operative (n=20)	Non-operative (n=30)	Effect summary	P value
Liver injury	10 (50.0)	12 (40.0)	OR 1.50 (95% CI 0.48-4.69)	.485
Splenic injury	8 (40.0)	13 (43.3)	OR 0.87 (95% CI 0.28-2.75)	.815
Bowel injury	4 (20.0)	5 (16.7)	OR 1.25 (95% CI 0.29-5.37)	1.000
Renal injury	3 (15.0)	2 (6.7)	OR 2.47 (95% CI 0.37-16.32)	.377
Any extra-	13 (65.0)	18 (60.0)	OR 1.24 (95% CI	.721

abdominal injury			0.38-4.00)	
Head injury	5 (25.0)	6 (20.0)	OR 1.33 (95% CI 0.35-5.15)	.736
Chest injury	4 (20.0)	8 (26.7)	OR 0.69 (95% CI 0.18-2.68)	.740

INTERPRETATION

Liver and splenic trauma dominated the abdominal injury spectrum in both groups, while associated extra-abdominal injuries were common. Yet no single organ injury pattern independently separated operative from non-operative patients. This supports the current trauma principle that organ identity alone is an insufficient trigger for laparotomy. Instead, surgery appears to have been driven by the grade, physiologic expression, and clinical consequences of injury, especially when bleeding or peritoneal irritation raised concern for evolving instability.

TABLE 3. RESOURCE USE AND CLINICAL OUTCOMES BY MANAGEMENT GROUP

Variable	Operative (n=20)	Non-operative (n=30)	Effect summary	P value
ICU stay, days	3.00 [2.00-4.00]	1.00 [0.25-2.00]	Rank-biserial r=-0.577	<.001
Hospital stay, days	11.35 ± 2.21	6.83 ± 1.78	Cohen's d=2.302	<.001
Any complication	8 (40.0)	7 (23.3)	OR 2.19 (95% CI 0.64-7.50)	.208
In-hospital mortality	2 (10.0)	0 (0.0)	OR 8.24 (95% CI 0.37-181.32)	.155
Laparotomy performed	16 (80.0)	0 (0.0)	OR 223.67 (95% CI 11.33-4414.80)	<.001
Hospital stay >7 days	20 (100.0)	9 (30.0)	OR 92.79 (95% CI 5.07-1699.09)	<.001

INTERPRETATION

Resource use diverged much more clearly than crude adverse outcomes. Operative patients needed longer ICU care and longer hospitalization, and prolonged stay beyond 7 days was almost universal in this subgroup. Complications and mortality also trended upward, although the sample was too small for precise estimates. The pattern suggests that surgery identified patients with heavier biological insult and recovery burden, even when low event rates limited statistical separation for uncommon outcomes such as death.

TABLE 4. OUTCOMES ACROSS NISS CATEGORIES

Outcome	≤15 (n=10)	16-24 (n=10)	≥25 (n=30)	P value
Operative management	0/10 (0.0)	0/10 (0.0)	20/30 (66.7)	<.001
Laparotomy	0/10 (0.0)	0/10 (0.0)	16/30 (53.3)	<.001
Any complication	3/10 (30.0)	2/10 (20.0)	10/30 (33.3)	.728
In-hospital mortality	0/10 (0.0)	0/10 (0.0)	2/30 (6.7)	.499
Any ICU stay	8/10 (80.0)	6/10 (60.0)	25/30 (83.3)	.300
Hospital stay >7 days	1/10 (10.0)	4/10 (40.0)	24/30 (80.0)	<.001

INTERPRETATION

NISS categories showed a pronounced dose-response relationship with intervention burden. No patient with NISS below 25 required operative management or laparotomy, whereas two-thirds of those with NISS 25 or above underwent surgery and most experienced prolonged hospitalization. The weaker gradient for complication and mortality likely reflects sparse events rather than absence of risk. As a practical tool, NISS appeared more useful for anticipating procedural intensity and bed occupancy than for predicting rare short-term endpoints in this cohort.

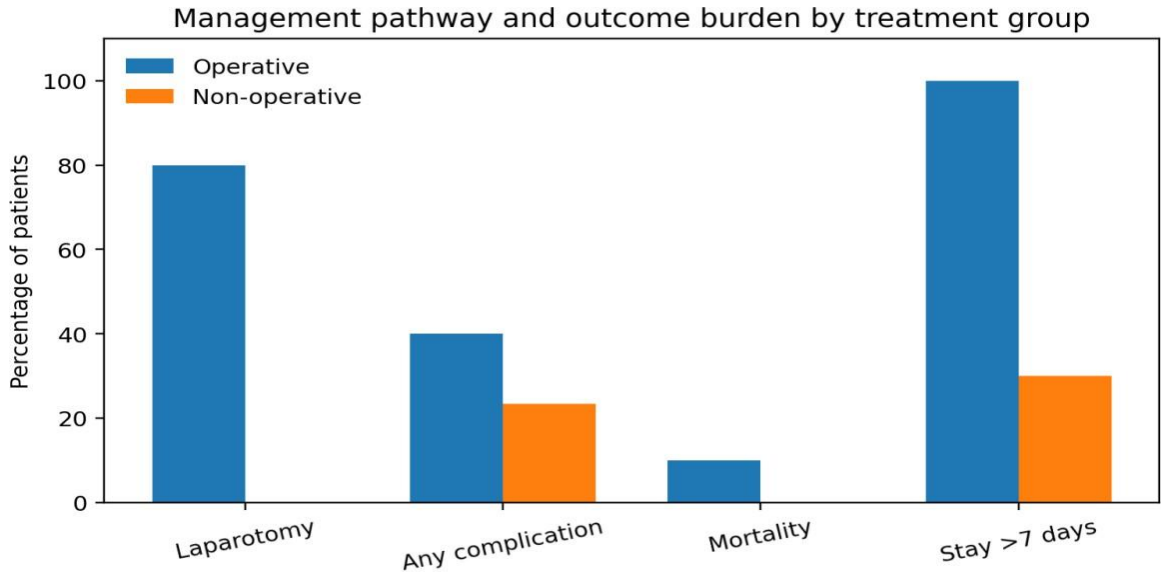

Figure 1. Management pathway and major outcome burden by treatment group

INTERPRETATION

The figure visually emphasizes how strongly management pathway tracked downstream resource consumption. Laparotomy and hospital stay beyond 7 days clustered in the operative arm, while complication and mortality remained less frequent and therefore statistically less stable. This visual profile is clinically important because it shows that operative care in abdominal trauma may be better understood as a marker of severity and convalescent burden than as a simple binary exposure, particularly in smaller hospital-based cohorts.

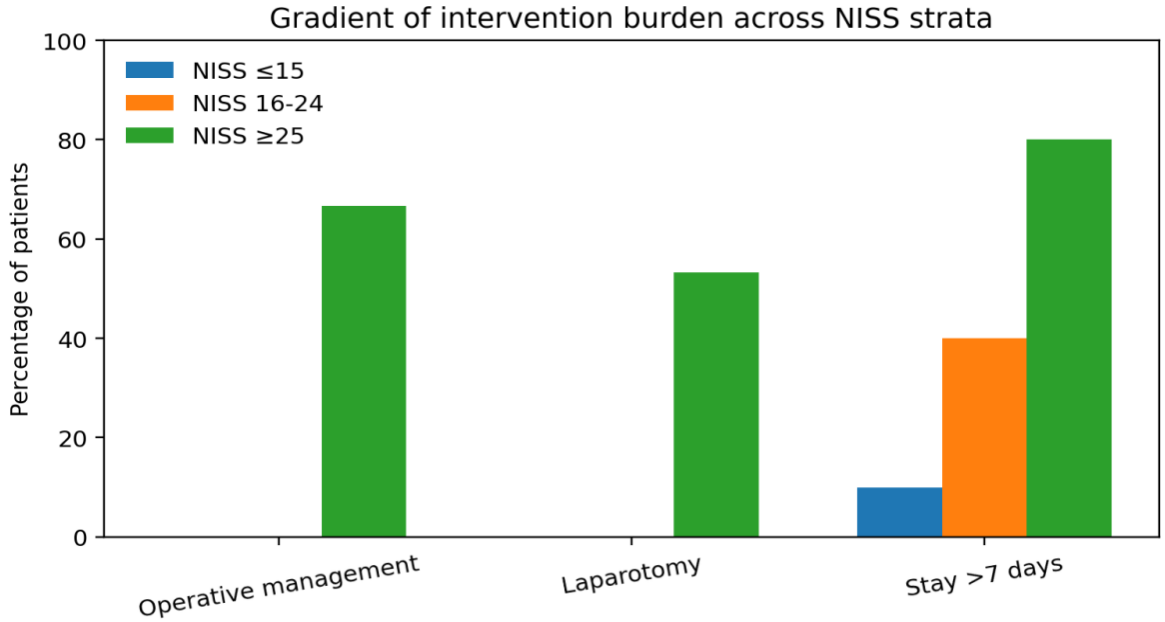

Figure 2. Escalation of operative burden across NISS strata

INTERPRETATION

The stepwise increase in operation, laparotomy, and prolonged stay across NISS categories reinforces the validity of an anatomic severity framework for abdominal trauma triage. The absence of a comparable rise in lower NISS strata suggests that patients with limited injury burden can often be managed safely without surgery. Conversely, the sharp escalation beyond NISS 25 identifies a subgroup that may benefit from intensified surveillance, earlier senior review, and proactive critical care planning.

DISCUSSION

This prospective single-center intervention indicated that overall care of abdominal trauma was significantly determined by injury severity and physiological pressure rather than a demographic profile and mechanism alone. Patients managed by

operative treatment had significantly higher AIS component scores, a 2-fold greater mean NISS, higher CASS, longer ICU, and longer total stay in the hospital than non-operative patients, while sex distribution, smoking history, injury type, mechanism of injuries, and time to presentation made no difference. Such pattern can be of clinical significance and may accord with contemporary trauma management, as in which the patient-based decision-supportive practice is based on the patient's hemodynamic response, imaging-based injury value, and response to bleeding status and the possibility of the patient continuing bleeding or visceral contamination over and above just the cause [3,4,7,9]. Additionally, the broader demographic and mechanistic character of our cohort aligned with the previous abdominal trauma series. Men accounted for a high percentage while road traffic injury was the primary mechanism and this was in agreement with prospective data from northern Tanzania and registry data from Scotland [9,10]. They also showed the large burden of blunt injury in much of contemporary centres and that extra-abdominal injuries were common. These incidents described common injuries on our series but did not indicate operative versus non-operative care. Such an insight suggests that a concurrent trauma may compound difficulty of abdominal exploration while not motivating abdominal exploration if physiologic instability is absent or abdominal assessments are concealed. All the results highlight an average organ-injury signature similar with the current literature about blunt abdominal trauma [4,7,11,12], liver and spleen are responsible for the majority of injuries. Significantly, the association between the type of isolated organ and disease treatment pathway is poor. Current liver and splenic guidelines emphasize that patients with multiple solid-organ injuries who are hemodynamically stable are non-intensive; they can be safely treated on admission, provided close surveillance, cross-sectional imaging, and rescue can be performed [7,11]. High-profile observational studies and guideline reviews have demonstrated good adherence with nonoperative management of blunt hepatic and splenic injuries, even with specific high-grade injury [11,12]. Our data fell within that paradigm: the ultimate deciding signal for surgery wasn't only liver or splenic injury, but also the degree of accompanying acute injury. Furthermore, the study also emphasizes the disparity in number of injured organ and severity of the injury. The abdomen injury count was comparable between operative and non-operative patients, although operative group had higher AIS and NISS values compared to non-operative group. This supports the theoretical advantage of NISS, which treats the three most severe injuries independently depending on body region and therefore measures the concentrated injury burden a good deal more accurately than simple organ counting. In meta-analytic and comparative studies, NISS performances in predicting mortality and allocation of resources have also been shown to be better and in some instances also at least on par with other traditional scores [13-15]. In our cohort, NISS was significantly correlated to length of hospitalization and stay in ICU and had a strong gradient for operative management, laparotomy, and length of stay in the ICU. These results suggest that NISS is especially useful for predicting intervention burden and beds used for abdominal trauma. CASS showed a weaker signal. Operative patients showed marginally higher CASS values, CASS appeared to be associated with ICU stay, but categorical CASS strata did not differentiate operation, laparotomy, complication and mortality as significantly. Past investigations describing CASS also have reported good bedside performance predictors of mandatory laparotomy in blunt abdominal trauma; in Indian studies, the additional advantage of CASS can previously be supported by its ability to associate well with other trauma scores [16,17]. So our findings were in part supportive, but not as good as those reports. One explanation should be case-mix heterogeneity where CASS is physiology-heavy score and might be more informative in small blunt trauma cohort relative to mixed abdominal trauma cohort where there are relatively small numbers of deaths and a high fraction of patients successfully managed without surgery. The signal of mortality in this series was directionally plausible but was also underpowered. Overall in-hospital mortality was 4.0% and was lower than a few operative abdominal trauma reports across resource-poor populations, falling within the range that can be expected for mixed cohorts with a significant non-operative aspect [9,10]. Non-survivors presented significantly greater NISS and mortality was numerically greater for those treated with operative procedure and laparotomy, however, a small number of events reduced the estimation. Death is more often caused by shock, associated head injury, severe vascular and pancreatic trauma and a failure to achieve final control in a timely fashion [10,18]. Our findings support that literature, though the sample size was insufficient to reveal robust independent predictors of mortality. One important negative factor is the insignificant relationship between presentation time and the approach to management and complication. This is in contrast to reports linking delayed access to care to poorer outcome, notably in resource-limited settings [9]. One of the more likely approaches would be that most of our cohort patients arrived within an early period of narrow window, thereby reducing the discriminative ability of the intervention. By comparison, the pulse rate at presentation was substantially higher than that of laparotomy patients, highlighting the clinical importance of early physiologic activation even in the presence of systolic pressure. All the limitations of this study have appeared. Sample size was small, a rare outcome i.e. mortality too rare for any stable multivariable modelling. Given that sicker patients were one of the most likely to have surgery the observational approach introduced confounding by indication. Not all the patients had different granular variables (lactate, base deficit, transfusion requirement, CT contrast blush, formal organ grade and use of interventional radiology) [8]. In-hospital follow-up was limited to hospital. However, the research provides locally applicable evidence that can be used to guide the triage, audit and development of standards of care. Further multicentre studies in large Indian samples need to validate these results by physiologic biomarkers and/or imaging grade, and consider the prospects of severity-guided trajectories leading to a shorter duration of definitive intervention by minimizing non-therapeutic laparotomy.

CONCLUSION

At this tertiary care hospital, outcomes of abdominal trauma were largely determined by both the severity of the cumulative

injury and early physiologic strain. Patients undergoing surgery had significantly higher NISS and CASS scores, had more severe AIS profiles, and were used significantly more ICU and hospital resources while demographic and broad injury mechanism factors were poor discriminators of management pathway. NISS played a greater role (higher for intervention burden and length of stay) than limited CASS as the supplemental bedside stratification. This enables selective, severity-based decision-making, thorough monitoring of high-risk patients, and continued evolution of protocols for early triage, imaging, and timely escalation of operative management of abdominal trauma.

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